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GUIDELINES FOR THE DESIGN, APPROVAL AND OPERATION OF SEWAGE LAGOON SYSTEMS FOR SMALL MUNICIPAL DEVELOPMENTS

Alberta
ENVIRONMENT

GUIDELINES FOR THE DESIGN, APPROVAL AND OPERATION OF SEWAGE LAGOONS FOR SMALL MUNICIPAL DEVELOPMENTS

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September, 1986

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PREFACE

These guidelines outline Alberta Environment requirements pursuant to the Alberta Clean Water Act for the design and approval of sewage lagoons serving small municipal developments in Alberta having a design average day flow of less than 15,000 gallons (70 m^3). For developments with flows greater than this, the Alberta Environment Standards for Water Supply Facilities, Sewage Works and Storm Drainage Systems apply.

These guidelines apply to any unincorporated rural development of two or more residences in which subdivision of a parcel has occurred for the purpose of establishing separate ownership of each lot. These guidelines do not apply to a sewage lagoon system serving a single farm site on which there is more than one residence, nor is a Permit to Construct required for such.

The procedures for obtaining a Permit to Construct and Licence to Operate for sewage lagoon systems serving small municipal developments are also described in these guidelines. Construction approval for such systems will only be considered if the following conditions are met:

1. the rural municipality favours the proposed development and is in agreement with the sewage lagoon concept for the proposed development;

2. the rural municipality has no objections to the detailed engineering drawings for the sewage lagoon system; and

3. Alberta Environment is satisfied that the system meets the standards outlined in these guidelines in addition to any other relevant guidelines, standards, or regulations.

These guidelines do not apply to existing sewage lagoon systems serving small unincorporated municipal developments, however existing systems which are upgraded will be required to meet the design standards of these guidelines. Permits to Construct and Licences to Operate for such upgraded systems will be issued either to the owner(s) of the system or the rural municipality, whichever the rural municipality requests.

SECTION 1

INTRODUCTION

The long detention sewage lagoon or "oxidation lagoon" is a pond for the storage and treatment of sewage. The natural combination of oxygen-using bacteria and oxygen producing algae occurring in such ponds convert the organic wastes into stable end products and produce a final effluent which can be discharged to the nearest acceptable drainage course. Where no discharge is possible, effluent may in certain cases be used to irrigate crops or simply be allowed to evaporate by natural processes.

Assuming proper design and operation, a long detention sewage lagoon will provide a satisfactory method of sewage treatment equal to and often better than that of a complete mechanical secondary sewage treatment plant. Lagoon treatment of sewage is especially advantageous for small municipal developments where land is available at low to moderate cost. The sewage lagoon will also provide treatment and disposal of sewage with a minimum of cost and effort.

SECTION 2

APPLICATION FOR A PERMIT TO CONSTRUCT

When a sewage lagoon for a small municipal development (as defined in the preface of these guidelines) is to be installed, it shall be designed to meet requirements outlined in these guidelines. Pursuant to Section 3 of the Clean Water Act and Section 4 of the Clean Water (Municipal Plants) Regulations, a municipal sewage lagoon system shall not be constructed without obtaining a Permit to Construct from the Director of Standards and Approvals, Alberta Environment.

Permit to Construct applications must be made directly by either the rural municipality in which the development is located or by the ultimate owner of the sewage system (or by an agent acting on their behalf). Permits to Construct for systems meeting Alberta Environment's requirements and having the approval of the rural municipality will be issued only to the rural municipality or the ultimate owner of the system.

To apply for this Permit, the following information must be submitted to the Director, Standards and Approvals Division, Alberta Environment, 4th Floor, Oxbridge Place, 9820 - 106 Street, EDMONTON, Alberta, T5K 2J6.

1. A letter outlining the following information:

   a) the number of serviced lots or the design population of the proposed development;
   b) the legal land description of the sewage lagoon;
   c) the proposed method of disposing of final effluent from the lagoon; and,
   d) the name of the ultimate owner of the facility.

2. A plan showing the location for the sewage lagoon in relation to residential and other buildings, roads, railroads, and proposed drainage course(s) within at least a one-half mile (800 metres) radius.

3. A plan of the lagoon, including:

   a) overall area plan;
   b) cross-sections;
   c) locations of inlet and outlet;
   d) size and depth; and,
   e) volume at design capacity (imperial gallons or cubic metres).

4. Information pertaining to the proposed drainage course into which effluent is to be discharged, including the name of the receiving creek or stream. Where discharge of effluent is not feasible, the owner may investigate either irrigation with the final effluent or construction of an evaporation pond.

5. Geotechnical (soils) data at the site of the proposed lagoon.

6. A copy of, or proof of, approval of the project concept and design by the Local Authority (rural municipality) in which the sewage lagoon is located.

SECTION 3

APPLICATION FOR A LICENCE TO OPERATE

In accordance with Section 4 of the Clean Water Act and Section 7 of the Clean Water (Municipal Plants) regulations, the ultimate owner of the municipal sewage lagoon shall apply for and obtain a Licence to Operate before commencement of system operation. Applications for a Licence to Operate will also be accepted from the Local Authority, either on behalf of the ultimate owners of the system or as operator of the lagoon system.

To apply for this Licence to Operate, the application shall be submitted to the Director, Standards and Approvals Division, Alberta Environment, 4th Floor, Oxbridge Place, 9820 - 106 Street, Edmonton, Alberta, T5K 2J6. The proponent shall also submit "as-built" drawings when applying for a Licence.

Licence application forms may be obtained from the Municipal Engineering Branch, Standards and Approvals Division of Alberta Environment, 427-5877.

SECTION 4

DESIGN CONSIDERATIONS

Prior to the design of the sewage lagoon for small municipal developments, it is important to establish the design criteria. These criteria include the design population and per capita sewage flow, and form the basis of preliminary design work. The design criteria can differ depending on the site of the sewage lagoon, the availability of an acceptable drainage course, and the type of development being considered, i.e., mobile home park, trailer court, etc. For the determination of precise design criteria, it is advisable to contact the Municipal Engineering Branch, Standards and Approvals Division, Alberta Environment, prior to initiating the design of the sewage lagoon.

All sewage lagoons for small municipal developments must be designed as shallow ponds having a maximum operating water depth of five feet (1.5 metres). There are two major alternative preliminary design considerations, including:

1. Discharge of final effluent to a drainage course once per year in the fall after farming operations have ceased. The minimum required detention time is therefore one year at design population.

2. No discharge of effluent. Here the designer is faced with two choices, namely:

   a) an evaporation pond. The minimum design storage shall be calculated using information related to design sewage flows, surface area of the lagoon, and evapotranspiration;
   b) a one year storage lagoon, using the final effluent for irrigation of certain crops. As guide to proponents considering wastewater irrigation, Alberta Environment has

prepared a publication entitled A Practical Guide to Municipal Wastewater Irrigation. This publication is available upon request.

The design of a sewage lagoon is to be such that there is a level bottom, and incoming sewer line(s) should be situated near the centre of the lagoon bottom for effective distribution of sewage. The outlet pipe shall be placed so that one foot (0.30 metre) of a liquid depth remains in the pond after maximum drawdown. A buried pipe or open ditch can transport final effluent directly to the drainage course.

Other design considerations include the following:

1. Lagoon berms and bottoms are to be relatively impervious in order to control seepage of wastewater. For additional information regarding site specific liner requirements, please contact the Municipal Engineering Branch, Standards & Approvals Division of Alberta Environment.

2. The sewage pond must be located at least 100 feet (30 metres) from any rural road, 300 feet (90 metres) from any numbered primary or secondary highway, 300 feet (90 metres) from any residence on the site of proposed development, and at least 1000 feet (300 metres) from any residence located either outside the proposed site of development or not directly associated with the facility.

3. Lagoons designed to discharge final effluent should be located as near as possible, but no closer than 75 feet (23 metres), to a well defined drainage course. In certain instances where the bank of the drainage channel is steep or the channel depth exceeds 50 feet (15 metres), a greater setback distance may be required.

4. The lagoon size shall be based on a minimum loading of 50 Imperial Gallons (0.25 cubic metres) per person per day, or 150 Imperial Gallons (0.70 cubic metres) per mobile home unit. More than one cell may be used to provide the required detention time. Refer to Table I on p. 4.5 for calculation of required lagoon volumes and size based on any given design population.

5. Fencing of the sewage lagoon is required (for barbed wire use minimum of four strands), and proper warning signs shall be provided. Where the sewage lagoon is located near residential developments, a chain link fence preventing the entrance of children may be required.

6. There shall be an all-weather access road to the lagoon.

7. Surface runoff is to be diverted around the lagoon.

Design details must conform to the following:

1. Berms shall conform

   a) inside and outside slopes are to be three horizontal to one vertical;
   b) the flat width at top of the berm is to be 10 feet (3.0 metres);
   c) the vertical distance between the high water level and the top of the berm is to be a minimum of two feet (0.60 metres). This "freeboard" distance allows for fluctuation of the operating high water level in the lagoon.

2. Inlet

   The inlet should be located away from the inside edge of the lagoon and located at the bottom of the lagoon.

3. Outlet

The outlet drain should be valved and an overflow outlet installed. The overflow is to be constructed to control the height of water in the lagoon and to protect the berms from overtopping as a result of pressure from lagoon contents.

4. Pond Configuration

The required storage can be provided in one or more ponds, and the shape of the pond(s) is not critical.

5. Piping and Manholes

All sewer piping into the lagoon must be buried to prevent freezing. The minimum ground cover is to be 8 feet (2.5 metres) for all gravity lines and 6 feet (1.8 metres) for force mains. The invert of the manhole immediately upstream of the lagoon should be above the high water level of the lagoon to prevent solids deposition. The minimum size diameter of gravity sewers is to be 8 inches (20 centimetres) installed at a minimum grade of 0.40 per cent (0.40 feet of drop per 100 feet of sewer length, or 12 centimetres of drop per 30 metres of sewer length). Minimum size diameter for a force main shall be 4 inches (10 centimetres). Manholes of minimum 42 inch (105 centimetres) diameter are to be installed at the end of each gravity line, at all gravity sewer junctions, and at all grade changes. The maximum length of gravity sewer between manholes shall be 400 feet (120 metres).

See Figure 1 for a typical drawing of a long detention sewage lagoon.

TABLE I

CALCULATION OF SEWAGE LAGOON VOLUME

Volume in Imperial Gallons	Size at Base	Size at Mid-Depth 2.5 Feet of Water	Size at 5 Foot Water Level	Size at Top of Berm 2 Foot Freeboard & 7 Feet Above Bottom of Lagoon
30,420	15' X 15'	30' X 30'	45' X 45'	57' X 57'
40,560	20' X 20'	35' X 35'	50' X 50'	62' X 62'
52,260	25' X 25'	40' X 40'	55' X 55'	67' X 67'
65,520	30' X 30'	45' X 45'	60' X 60'	72' X 72'
80,340	35' X 35'	50' X 50'	65' X 65'	77' X 77'
96,720	40' X 40'	55' X 55'	70' X 70'	82' X 82'
134,160	50' X 50'	65' X 65'	80' X 80'	92' X 92'
177,840	60' X 60'	75' X 75'	90' X 90'	102' X 102'
227,760	70' X 70'	85' X 85'	100' X 100'	112' X 112'
414,960	100' X 100'	115' X 115'	130' X 130'	142' X 142'
570,960	120' X 120'	135' X 135'	150' X 150'	162' X 162'
851,760	105' X 150'	165' X 165'	180' X 180'	192' X 192'
1,128,660	175' X 175'	190' X 190'	205' X 205'	217' X 217'
1,444,560	200' X 200'	215' X 215'	230' X 230'	242' X 242'
2,193,360	250' X 250'	265' X 265'	280' X 280'	292' X 292'
3,098,160	300' X 300'	315' X 315'	330' X 330'	342' X 342'
5,375,760	400' X 400'	415' X 415'	430' X 430'	442' X 442'

NOTE: To calculate lagoon volumes of square or rectangular sizes not shown above, the following formula may be used based on an inside berm slope of 3 horizontal to 1 vertical.

$$\text{Volume} = \frac{H}{6} (A + 4B + C) \times 6.24$$

= Imperial Gallons [may convert to cubic metres by dividing volume (IG) by 220].

H = Depth of pond - maximum of 5 feet
A = Area of bottom of pond in square feet
B = Area of the mid-depth in square feet
C = Area at the high water level (maximum 5 foot depth) in square feet

SECTION 5

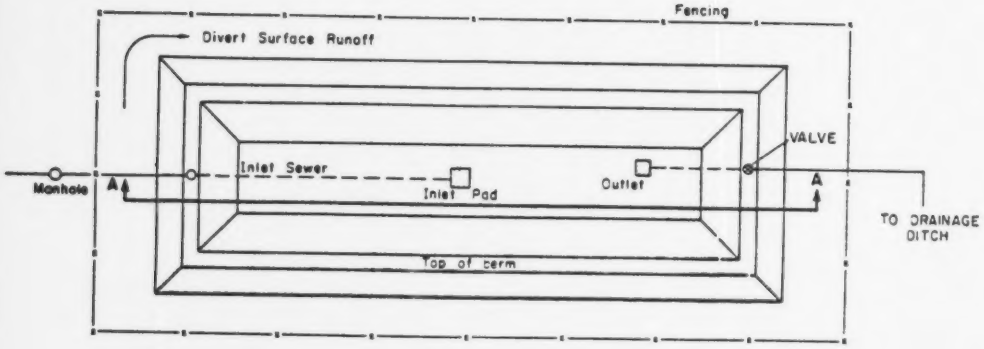
OPERATION AND MAINTENANCE

The operation of a sewage lagoon requires regular inspection of mechanical parts, and the control of grass and weed growth on the berm area. A short growth on the berms is helpful in reducing erosion, and cutting is recommended two or three times a year.

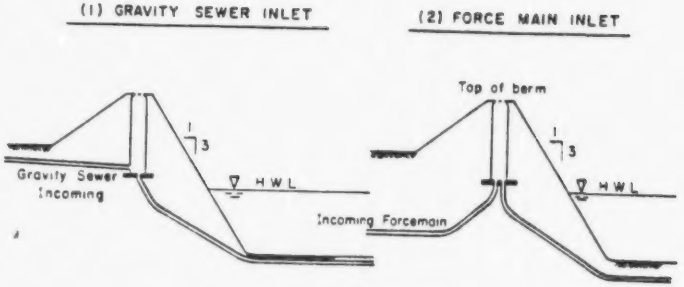
To prevent the lagoon from freezing solid during winter months, care should be taken to ensure that a minimum liquid depth of two feet (60 centimetres) is provided in the late fall. Lagoons at any time should not be drained to a water depth of less than one foot (30 centimetres) to safeguard against exposure of lagoon bottom. Discharge of final effluent may generally only occur during the late fall, however in special situations an annual spring discharge may be considered.

In all cases, consideration and notification must be given to owners of land which may be affected by the discharge of final effluent.

FIG. 1 A TYPICAL SMALL MUNICIPAL SEWAGE LAGOON

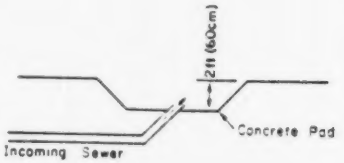


(A) PLAN

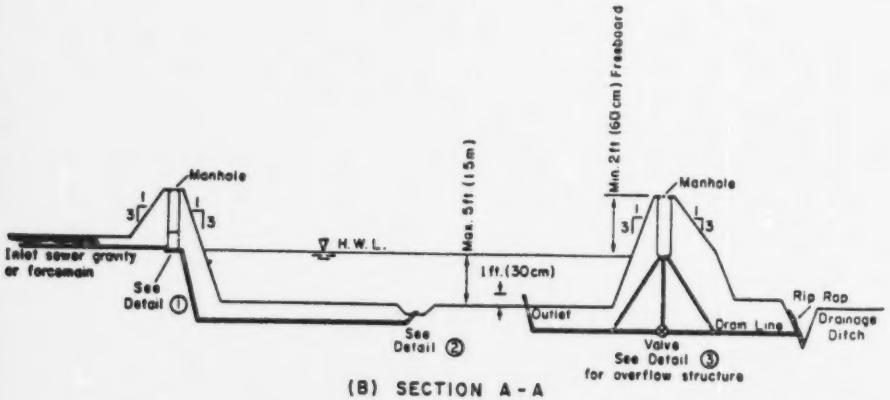


(C) DETAIL ① INLET

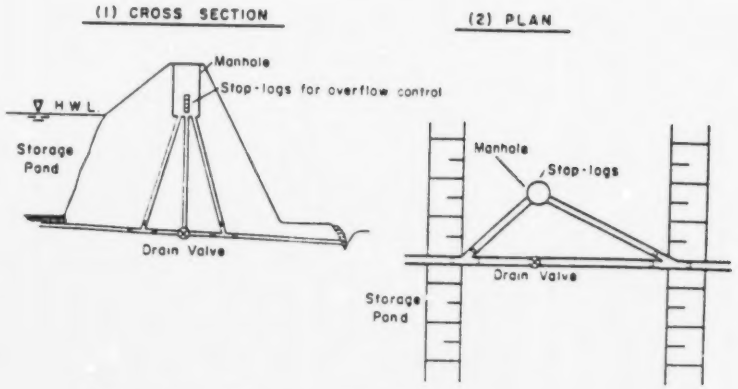
NOTE : H.W.L. is below elevation of manholes.



(D) DETAIL ② SUBMERGED INLET



(B) SECTION A-A



(E) DETAIL ③ OUTFALL AND OVERFLOW STRUCTURE